Attorney's Docket No. 1034172-000017

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of	
Yi-Qun Li et al.	Group Art Unit: 1755
Application No.: 10/829,590	Examiner: Koslow, Carol M.
Filed: April 21, 2004	Confirmation No.: 6712
For: MAGNETIC DOPED PEROVSKITE OXIDES	

LETTER AND/OR PETITION TO THE DIRECTOR TO REVIEW APPLICATION ABANDONED DUE TO PATENT OFFICE ERROR PURSUANT TO 37 CFR 1.10

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Applicant respectfully requests that the Director set aside the abandonment and review the above-identified applied application for patent on the grounds of Patent Office error based on the proofs set forth below.

1. On or about April 21, 2004, the subject application was duly filed in the U.S.P.T.O. by the applicant stating a correspondence address of:

Intematix Corp.
351 Rheem Blvd.
Moraga, CA 94556

2. On or about July 9, 2004 a Filing Receipt and Notice to File Missing Parts was sent to the applicant at the above address.

3. Subsequent to July 9, 2004, applicant retained the law firm of Burns, Doane, Swecker & Matthis, LLP to represent them before the U.S. Patent Office with regard to the subject application.

4. On or about November 9, 2004, Stephen F. Powell, Registration No. 43,014 of the firm of Burns, Doane, Swecker & Matthis, LLP, forwarded to the U.S. P.T.O. by

Express Mail under cover of Express Mail Mailing Label No. EV 346846245 US, a packet of documents including:

a. Transmittal Letter for Missing Parts of Application;
b. Petition for 2 Months Extension of Time;
c. Executed Declaration/Power of Attorney;
d. Substitute Specification including abstract (11 pages); and
e. Replacement Fig. 1.

Copies of the above-referenced documents are enclosed herewith.

5. Also enclosed was a return postcard listing all of the above and in particular, applicant's executed Declaration/Power of Attorney appointing the Burns, Doane, Swecker & Matthis, LLP firm as attorneys of record associated with U.S.P.T.O., Customer No. 21839 and to prosecute the subject application and transact all business in the Patent and Trademark office in connection therewith.

6. The postcard acknowledging receipt of the above-referenced documents was acknowledged and accepted effective November 9, 2004 by a date stamp on the This stamped postcard was forwarded to the Law Offices of Burns, Doane, Swecker & Matthis, LLP. We herewith enclose a copy of this postcard for your convenience.

7. On information and belief, a Notice of Abandonment was sent to applicant at their above stated business address, an address they had vacated long prior to February 13, 2006, and as a consequence they did not receive same.

8. No Notice of Abandonment or copy thereof was received from the U.S. P.T.O. at the firm of Burns, Doane, Swecker & Matthis, LLP.

9. On April 12, 2006, Krista Chaffin-Penny, secretary to the undersigned called the U.S.P.T.O. to check on the status of the application and was informed that the application was abandoned in February and a copy of the Notice of Abandonment was sent to her at her request. On this date, Ms. Chaffin-Penny also contacted the Virginia Office of Buchanan Ingersoll (formerly Burns, Doane, Swecker & Matthis, LLP) and obtained a copy of the stamped postcard attached hereto.

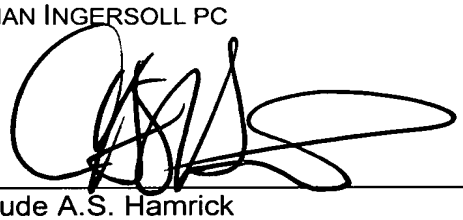
10. Applicant respectively submits that the abandonment was entirely not of their own doing and in fact was the result of the Patent Office error of sending the documents to applicant's former address and not to their attorney's address, as requested in their Power of Attorney filed in the U.S.P.T.O. on or about November 9, 2004, as acknowledged by the attached copy of the date stamped postcard.

11. Accordingly, applicant requests that the subject application be revived forthwith and that the examination continue based on the enclosed copies of papers previously filed in the U.S.P.T.O. on or about November 9, 2004.

In the event that any fee is required, the U.S.P.T.O. is authorized to charge such fee to Deposit Account No. 02-4800.

Respectfully submitted,

BUCHANAN INGERSOLL PC



Date: April 27, 2006

By: _____
Claude A.S. Hamrick
Registration No. 22,586

P.O. Box 1404
Alexandria, Virginia 22313-1404
(650) 622-2300

Patent Response Postcard

Inventor: Yi-Qun Li et al. **Appln. No.:** 10/829,590 **Filing Date:** April 21, 2004

Docket No.: 034172-017 **Working Atty.:** SFP/kcp **Date:** November 9, 2004

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The following was/were received in the U.S. Patent and Trademark Office on the date stamped hereon:

- ☐ Amendment or Response
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- ☐ Submission of Formal Drawings w/ _____ sheet(s) of drawings (Fig(s). 1-_____)
- ☐ Request for Approval of Drawing Changes w/ _____ sheet(s) of red ink drawings
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- ☐ Certificate Under 37 C.F.R. 3.73(b)
- ☒ Transmittal Letter for Missing Parts of Application
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- ☐ Assignment/Assignment Recordation Form Cover Sheet (PTO-1595)
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- ☒ Check for $ 419.00 is enclosed
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- ☐ Filed by Certificate of Mail
- ☒ Substitute Specification including abstract (11 pages)
- ☒ Replacement Fig. 1
- ☐
- ☐

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Patent

Attorney Docket No. 034172-017

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Yi-Qun Li et al.
Application No.: 10/829,590
Filing Date: April 21, 2004
Title: MAGNETIC DOPED PEROVSKITE OXIDES

Group Art Unit: 1755
Examiner: Unassigned
Confirmation No.: 6712

TRANSMITTAL LETTER FOR MISSING PARTS OF APPLICATION

MAIL STOP MISSING PARTS
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

In complete response to the Notice to File Missing Parts of Application filed Under 37 C.F.R. § 1.53(b) dated July 9, 2004, enclosed please find:

- ☒ a Combined Declaration and Power of Attorney signed by the inventor(s);
  - ☐ Note that the inventor/inventors identified on the concurrently filed Combined Declaration and Power of Attorney is/are different than listed on the application filing papers.
- ☐ an Application Data Sheet;
- ☒ the surcharge of ☒ $65.00 (2051) ☐ $130.00 (1051) as set forth in 37 C.F.R. § 1.16(e);
- ☐ a Request for Refund;
- ☒ a Petition for Extension of Time;
- ☐ a verified English translation of the Application, and the $130.00 (1053) fee as set forth in 37 C.F.R. § 1.17(k);
- ☐ an Assignment document and a separate check for the $40.00 (8021) Assignment recordation fee;
- ☐ drawings for publication;
- ☐ IDS;
- ☐ a certified copy of the priority document; and
- ☒ other Substitute Specification including Abstract (11 pages), Replacement Fig. 1, and Return Postcard

Attorney Docket No. 034172-017
Application No. 10/829,590

☒ A check in the amount of $ 419.00 for the fee due for missing parts is enclosed.

☐ Charge _____ to Deposit Account No. 02-4800 for the fee due for missing parts.

☐ Charge _____ to credit card. Form PTO-2038 is attached.

☒ Small entity status is hereby claimed.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§ 1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

P.O. Box 1404
Alexandria, Virginia 22313-1404
(650) 622-2300

By Stephen F. Powell
Stephen F. Powell
Registration No. 43,014

Date: November 9, 2004

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Attorney Docket No. 034172-017

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Yi-Qun Li et al.
Application No.: 10/829,590
Filing Date: April 21, 2004
Title: MAGNETIC DOPED PEROVSKITE OXIDES

Group Art Unit: 1755
Examiner: Unassigned
Confirmation No.: 6712

PETITION FOR EXTENSION OF TIME

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

The following extension of time is requested to: respond to the Notice to File Missing Parts of Application dated July 9, 2004

two months to November 9, 2004 ☒ $215.00 (2252) ☐ $430.00 (1252)

☐ The shortened statutory period has been reset by an Advisory Action dated _____.

☒ An extension fee in the amount of $ 215.00 is enclosed.

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☐ Charge _____ to credit card. Form PTO-2038 is attached.

The Director is hereby authorized to charge any appropriate fees under 37 C.F.R. §§1.16, 1.17 and 1.21 that may be required by this paper, and to credit any overpayment, to Deposit Account No. 02-4800. This paper is submitted in duplicate.

Respectfully submitted,

BURNS, DOANE, SWECKER & MATHIS, L.L.P.

P.O. Box 1404
Alexandria, Virginia 22313-1404
(650) 622-2300

By Stephen F. Powell
Stephen F. Powell
Registration No. 43,014

Date: November 9, 2004

"Express Mail" Mailing Label No. EV 346846245 US

Date of Deposit 11/9/04

Patent

Attorney's Docket No. 034172-017

MAGNETIC DOPED PEROVSKITE OXIDES

CLAIMING OF THE BENEFIT OF PROVISIONAL PATENT

[0001] This application claims priority under 35 U.S.C. § 119 to U.S. Provisional Application No. 60/436,102 entitled Magnetic Doped Perovskite Oxides and filed on December 20, 2002.

FIELD OF THE INVENTION

[0002] This invention releases to provision of new compositions of metal oxide materials that have ferromagnetic or ferrimagnetic properties and have resistivity in a range from semiconducting to insulating.

BACKGROUND OF THE INVENTION

[0003] Recent discovery of optically induced quantum coherent spin-state in semiconductors has opened up a wide range of possibilities of spin-controlled devices, such as ultra-high speed spin-controlled-optical switching and modulation, and quantum spin phase logic devices. One of the major technical barriers to realize the implementation of these devices is the proper spin injection contact materials that will effectively inject spin polarized electrons into semiconductors. One approach is the development of room temperature ferromagnetic semiconductors. Spin injection through a ferromagnetic semiconductor heterostructure has been demonstrated. So far, there is no ferromagnetic or ferromagnetic materials have Curie temperature higher than room temperature (300K) and a resistivity of semiconductors. Most of ferromagnetic oxides are either metals or insulators. (Ga,Mn)As is only ferromagnetic semiconductor but its Curie temperature is as low as 120K. Some theoretical and experimental works indicate that (GaMn)N may exhibit room temperature ferromagnetism. But, unfortunately, the experimental result of Curie temperature of such material is only 250K. Several ferromagnetic metal oxides such as $(La,M)MnO_3$ (M=Ca, Sr, Ba, Pb, ...), $Sr(M_{0.5}Mo_{0.5})O_3$ (M=Fe, Mn, Co, Cr,..) have also been investigated for spin injection materials. However, these families of ferromagnetic oxides behave as metals with a relative high conductivity rather than semiconductors. Therefore, there is an urgent need to invent new materials that will enable effective injection of nearly 100% spin polarized electrons into semiconductors switched by low magnetic field at room temperature.

SUMMARY OF THE INVENTION

[0004] These needs are met by the invention, which provides several groups of compound semiconductor oxides in which spontaneous magnetization is existed with Curie temperatures higher than room temperature (>300K) and their conductivity can be controlled in a range from semiconducting to insulating.

[0005] General chemical compositions for groups of oxide materials with simple perovskite structures are $(A_{1-x}M_x)BO_3$, $(A_{1-x}M_x)(B'B'')O_3$ or $A(B_{1-x}M_x)O_3$, (where A can be 1+, 2+ and 3+ ions; B can be 5+, 4+, 3+ ions; B' and B" can be 2+, 3+, 4+, 5+ and 6+ ions, M is a magnetic ion dopant). Specific examples are $(A_{1-x}M_x)TiO_3$, $(A_{1-x}M_x)ZrO_3$, $(A_{1-x}M_x)SnO_3$, $(A_{1-x}B_x)HfO_3$, $La(Mo_{1-x}M_x)O_3$, $Sr(Ti_{1-x}M_x)O_3$ where A=Ca, Sr, Ba, Pb, Cd and M= Fe, Ni, Co, Mn with $0<x<0.15$ (?????).

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] Figure 1a, 1b, 1c, and 1d are theta-2 theta x-ray diffraction patterns for $(Ba_{0.94}Fe_{0.05})TiO_3$ $(Ba_{0.94}Co_{0.05})TiO_3$, $(Ba_{0.94}Ni_{0.05})TiO_3$, and $(Ba_{0.94}Fe_{0.05})ZrO_3$, respectively.

[0007] Figure 2 are plots of magnetization (μ_B/Fe) measured as a function of magnetic field at a temperature of 300K by SQUID magnetometer for a series of $(Ba_{1-x}Fe_x)TiO_3$ with x =0.01, 0.02, 0.03, 0.05, 0.07, and 0.1.

[0008] Figure 3 are plots of magnetization (μ_B/mol) measured as a function of magnetic field at a temperature of 300K by SQUID magnetometer for a series of $(Ba_{0.95}M_{0.05})TiO_3$ with M=Fe, Co, and Ni.

[0009] Figure 4 are plots of magnetization (μ_B/mol) measured as a function of magnetic field at a temperature of 300K by SQUID magnetometer for a series of $(Ca_{0.95}M_{0.05})TiO_3$ with M=Fe, Co, and Ni.

[0010] Figure 5 are plots of magnetization (μ_B/mol) measured as a function of magnetic field at a temperature of 300K by SQUID magnetometer for a series of $(Ba_{0.95}Fe_{0.05})BO_3$ with B=Ti, Zr, and Hf.

[0011] Figure 6 are plots of magnetization (μ_B/mol) measured as a function of magnetic field at a temperature of 300K by SQUID magnetometer for a series of $(Ca_{0.95}Fe_{0.05})BO_3$ with B=Ti, Zr, and Hf.

[0012] Figure 7 is a curve of magnetization as a function of temperature for $(Ba_{0.95}Fe_{0.05})TiO_3$ and $(Ca_{0.95}Fe_{0.05})TiO_3$ from 5K to 300K by SQUID magnetometer.

[0013] Figure 8 is a hysteresis loop of $(Ba_{0.94}Fe_{0.05})TiO_3$ and $(Ca_{0.94}Fe_{0.05})TiO_3$ measured at 5K and 300K by SQUID magnetometer.

[0014] Figure 9 is the (a) Magnetization vs Temperature, (b) hysteresis loop of $La(Mo_{0.25}Fe_{0.75})O_3$ at 300K measured using vibration vibrating samples magnetometer (VSM).

[0015] Figure 10 is the (a) Magnetization vs Temperature, (b) hysteresis loop of $Sr(Fe_{0.05}Ti_{0.95})O_3$ at 300K measured using vibration vibrating samples magnetometer (VSM).

DESCRIPTION OF BEST MODES OF THE INVENTION

[0016] The invention includes general chemical compositions of the forms

$(A_{1-x}M_x)BO_3$
$(A_{1-x}M_x)(B'B'')O_3$
$A(B_{1-x}M_x)O_3$

where A can be 1+, 2+ and 3+ ions; B can be 5+, 4+, 3+ ions; B' and B'' can be 2+ , 3+ 4+, 5+ and 6+ ions, M is a magnetic ion dopant such as Fe, Co, Ni and Mn.

[0017] Examples are:
$(A_{1-x}M_x)TiO_3$,
$(A_{1-x}M_x)ZrO_3$,
$(A_{1-x}M_x)SnO_3$,
$(A_{1-x}M_x)HfO_3$,
$A(B_{1-x}M_x)O_3$

where A=Ca, Sr, Ba, Pb, Cd, La, B=Mo, Ti, and M= Fe, Ni, Co, Mn with $0<x<0.15$. Representative bulk and thin film materials from these groups have been prepared by conventional ceramic powder process, ceramic solution process, and ion beam sputtering deposition, Laser ablation deposition respectively, for the choices of A= Ca and Ba, and, B=Ti and Mo, M = Fe, Co, and Ni.

Bulk samples of $(Ba_{1-x}Fe_x)TiO_3$ with x =0.01, 0.02, 0.03, 0.05, 0.07, and 0.1.
Bulk samples of $(Ca_{0.95}M_{0.05})TiO_3$ with M=Fe, Co, and Ni.
Bulk samples of $(Ba_{1-x}Fe_x)TiO_3$ with M=Fe, Co, and Ni.
Bulk samples of $(Ca_{0.95}Fe_{0.05})BO_3$ with B=Ti, Zr, and Hf.
Bulk samples of $(Ba_{0.95}Fe_{0.05})BO_3$ with B=Ti, Zr, and Hf.
Bulk sample of $La(Mo_{0.25}Fe_{0.75})O_3$.
Bulk sample of $Sr(Ti_{0.95}Fe_{0.05})O_3$.

[0018] Raw materials for preparing these samples are: Ba: $BaTiO_3$ or $BaCO_3$, Ca: CaO or $CaTiO_3$, Ti: TiO_2, Zr: ZrO_2, Hf: HfO_2, Fe: Fe_2O_3, Co: CoO, and Ni: NiO. La: La_2O_3, Mo: MoO_2, Sr: $SrCO_3$.

[0019] A method for producing these bulk ceramic materials comprises the following procedures:

1. Weighing the metal oxides according to the designed chemical stoichiometry.
2. Mixing these powders with solvent or water by ball milling for 20 minutes.
3. Drying the powder at 100°C for 1 hour.
4. The powder was calcined at 1100°C for 7 hours in air.
5. After ball milling, the dry powder was pressed into a cylinder pellet with a pressure of 100Mpa.
6. These pellets were fired at 1200-1350°C for 9-24 hours in N_2+H_2 or air atmosphere.

[0020] The samples of $(Ba_{1-x}Fe_x)O_2$ with X=0.01, 0.02, 0.03, 0.05, 0.07, and 0.1 exhibit magnetic properties with a increased saturation magnetization as X increases. The calculations of magnetization as contributed from each Fe ion are plotted in Figure 2. The sample with X from 0.01 to 0.05 has a similar magnetization per Fe ion with 2 Bohr

magnetrons per Fe, which is about half of a pure Fe^{++} ion. Magnetization per Fe deceases as substitution of Fe to Ba increases for more than 5%. The result indicates that the solutability of Fe in A site of BaTiO3 is about 5% due to the large difference of ion size between Ba^{2++} and Fe^{2++}. The precipitation of either Fe_2O_3 or Fe_3O_4 has magnetization per Fe less than 2 Bohr.

[0021] Two series of bulk samples of $(Ca_{0.95}M_{0.05})TiO_3$ and $(Ba_{0.95}M_{0.05})TiO_3$ with M=Fe, Co, and Ni were prepared. Figure 3 and Figure 4 are magnetization curves of $(Ca_{0.95}M_{0.05})TiO_3$ and $(Ba_{0.95}M_{0.05})TiO_3$ with M=Fe, Co, and Ni, respectively. All of the samples shows ferromagnetic property. The saturation magnetization decreases in a sequence of Fe, Co and Ni which is consistent with the sequence for pure Fe2+, Co2+, and Ni2+ except Ni doped materials has relatively lower magnetization.

[0022] Two series of bulk samples of $(Ca_{0.95}F_{0.05})BO_3$ and $(Ba_{0.95}Fe_{0.05})BO_3$ with B=Ti, Zr, and Hf were prepared. Figure 5 and Figure 6 are magnetization curves of $(Ca_{0.95}Fe_{0.05})BO_3$ and $(Ba_{0.95}Fe_{0.05})BO_3$ with B=Ti, Zr, and Hf, respectively. All of the samples show ferromagnetic property. The saturation magnetization increases slightly in a sequence of Ti, Zr, and Hf at B sites for both $(Ca_{0.95}F_{0.05})BO_3$ and $(Ba_{0.95}Fe_{0.05})BO_3$.

[0023] Figure 7 is a curve of magnetization as a function of temperature for $(Ba_{0.95}Fe_{0.05})TiO_3$ and $(Ca_{0.95}Fe_{0.05})TiO_3$ from 5K to 300K. The Curie temperature is clearly higher than 300K. The complete hysteresis loops of $(Ba_{0.95}Fe_{0.05})TiO_3$ and $(Ca_{0.95}Fe_{0.05})TiO_3$ are measured at 5K and 300K as shown in Figure 8.

[0024] The coercive fields and remanent magnetization at temperatures of 5K and 300K for selected samples are listed in Table 1.

Table 1

Magnetic Properties of $(Ba_{0.95}Fe_{0.05})MO_3$ and $(Ca_{0.95}Fe_{0.05})MO_3$ (M=Ti, Zr, Hf)

	Hc(300K) (Oe)	Mr(300K)x10^{-4} μB/Mol	Hc(5K) (Oe)	Mr(5K) x10^{-4} μB/Mol
$(Ba_{0.95}Fe_{0.05})TiO_3$	16	3.84	26	7.55
$(Ca_{0.95}Fe_{0.05})TiO_3$	12	2.7	26	5.96
$(Ba_{0.95}Fe_{0.05})ZrO_3$	25	4.6	51	9.6
$(Ca_{0.95}Fe_{0.05})ZrO_3$	4.5	2.3	103	3.4
$(Ba_{0.95}Fe_{0.05})HfO_3$	20	4.5	51	11
$(Ca_{0.95}Fe_{0.05})HfO_3$	7	2.3	68	16

[0025] Figure 9(a) is a curve of magnetization as function of temperature for bulk sample $La(Mo_{0.25}Fe_{0.75})O_3$. The curie temperature of the sample is as high as 940K, and different that of the candidate impurity phase, Fe_3O_4 (850K), which strongly rules out the existence of magnetic impurity Fe_3O_4 phase on the sample, and demonstrates the magnetic contribution of the doped Fe ions. The hysteresis loop of the sample measured at 300K using VSM is shown in Figure 9(b). The coercive fields and remanent magnetization at temperatures of 300K is 238Oe and 0.1589emu/g respectively.

[0026] Figure 10 shows the magnetic properties of the Fe-doped $SrTiO_3$ with 5% Fe substitutingTi. The sample was annealed under reduced atmosphere (N_2+5%H_2). It is clear that the sample exhibits ferromagnetism at room temperature with large coercive field(1170Oe, see Fig.10b) and a high curie temperature(610K, see Fig.10a)). The curie temperature of 530K can strongly evidence that the magnetism of the sample is from the doped Fe ion in the host lattices, rather than from the most possible impurity magnetic phase Fe_3O_4.

Claims

1. A ferromagnetic perovskite oxide materials having a formula of (A1-xMx)BO3 , where A is at least one non-magnetic element selected from group of Ca, Sr, Ba, Pb, Y, La, Gd; B is at least one non-magnetic element with selected from group of Ti, Zr, Hf, Sn, Mo, Ta, W, Nb, Al, Bi; M is at least one magnetic elements selected from group of Fe, Co, Ni, Cr, Mn, and V; And index x satisfies $0<x<0.15$;

2. The material composition of claim 1, A is Ca, Ba; B is Ti, Zr, Hf; and M is Fe, Co, Ni.

3. The Material composition according claim 2, wherein x is a range from 0 to 0.15.

4. The material composition of claim 2 having specific formula (Ba0.95Fe0.05)TiO3, wherein said saturation magnetization about 0.10μB/mol Fe at 300K, and the coercive fields about 16Oe at 300K.

5. The material composition of claim 2 having specific formula (Ca0.95Fe0.05)TiO3, wherein said saturation magnetization about 0.11μB/mol Fe at 300K, and the coercive fields about 12Oe at 300K.

6. The material composition of claim 2 having specific formula (Ba0.95Fe0.05)ZrO3, wherein said saturation magnetization about 0.11μB/mol Fe at 300K, and the coercive fields about 25Oe at 300K.

7. The material composition of claim 2 having specific formula (Ca0.95Fe0.05)ZrO3, wherein said saturation magnetization about 0.12μB/mol Fe at 300K, and the coercive fields about 4.5Oe at 300K.

8. The material composition of claim 2 having specific formula (Ba0.95Fe0.05)HfO3, wherein said saturation magnetization about 0.125μB/mol Fe at 300K, and the coercive fields about 20Oe at 300K.

9. The material composition of claim 2 having specific formula (Ca0.95Fe0.05)HfO3, wherein said saturation magnetization about 0.12μB/mol Fe at 300K, and the coercive fields about 7Oe at 300K.

10. A method for producing a ferromagnetic perovskite oxide ceramics, said method comprises the steps:

(1) Preparing individual metal oxide according to the desired stoichiometry for amounts of :

(a) metal oxides at least one non-magnetic element selected from group of Ca, Sr, Ba, Pb, Y, La, Gd; (b).metal oxides of at least one magnetic element selected from group of Fe, Co, Ni, Mn, and V; (c) metal oxides at least one non-magnetic element selected from group of Ti, Zr, Hf, Sn, Mo, Ta, W, Nb, Al.

(2) Mixing together said individual metal oxides (a), (b) and (c) to form a sigle mixture.

(3) Firing said mixture in argon or reducing atmosphere at temperature for a time sufficient to convert the said mixture to s single phase ferromagnetic perovskite oxides.

11. A method for producing ferromagnetic perovskite oxide thin films, said method comprises the steps of:

(1) Preparing a ceramic target comprising a ferromagnetic perovskite oxide composition of (a) metal oxides at least one non-magnetic element selected from group of Ca, Sr, Ba, Pb, Y, La, Gd; (b).metal oxides of at least one magnetic element selected from group of Fe, Co, Ni, Mn, and V; (c) metal oxides at least one non-magnetic element selected from group of Ti, Zr, Hf, Sn, Mo, Ta, W, Nb, Al.

(2) deposition of a ferromagnetic perovskite oxide thin film by sputtering the said ceramic target under Ar atmosphere or vacuum and temperature in a range of 400°C to 800°C.

(3) post-annealing of ferromagnetic perovskite oxide thin film in Ar atmosphere from 0 minutes to 2 hours.

12. A ferromagnetic perovskite oxide materials having a formula of A(B1-xMx)O3, where A is at least one non-magnetic element selected from group Ca, Sr, Ba, Pb,

Y, La, Gd; B is at least one non-magnetic element selected from group of Ti, Zr, Hf, Sn, Mo, Ta, W, Nb, Al, Bi; M is at least one magnetic element selected from group of Fe, Co, Ni, Cr, Mn, and V; And index x satisfies $0<x<0.15$;

13. The material composition of claim 12, A is La, Sr; B is Ti, Mo; and M is Fe.

14. The Material composition according claim 13, wherein x is a range from 0 to 0.15.

15. The material composition of claim 13 having specific formula La(Mo0.25Fe0.75)O3, wherein said magnetic Curie temperature is 940K, and the coercive fields about 238Oe at 300K.

16. The material composition of claim 13 having specific formula Sr(Ti0.95Fe0.05)O3, wherein said magnetic Curie temperature is 610K , and the coercive fields about 1170Oe at 300K.

17. A method for producing a ferromagnetic perovskite oxide ceramics, said method comprises the steps:

(1) Preparing individual metal oxide according to the desired stoichiometry for amounts of :

(a) metal oxides at least one non-magnetic element selected from group of Ca, Sr, Ba, Pb, Y, La, Gd; (b).metal oxides of at least one magnetic element selected from group of Fe, Co, Ni, Mn, and V; (c) metal oxides at least one non-magnetic element selected from group of Ti, Zr, Hf, Sn, Mo, Ta, W, Nb, Al.

(2) Mixing together said individual metal oxides (a), (b) and (c) to form a sigle mixture.

(3) Firing said mixture in argon or reducing atmosphere at temperature for a time sufficient to convert the said mixture to s single phase ferromagnetic perovskite oxides.

18. A method for producing ferromagnetic perovskite oxide thin films, said method comprises the steps of:

(1) Preparing a ceramic target comprising a ferromagnetic perovskite oxide composition of (a) metal oxides at least one non-magnetic element selected from group of Ca, Sr, Ba, Pb, Y, La, Gd; (b).metal oxides of at least one magnetic element selected from group of Fe, Co, Ni, Mn, and V; (c) metal oxides at least one non-magnetic element selected from group of Ti, Zr, Hf, Sn, Mo, Ta, W, Nb, Al.

(2) deposition of a ferromagnetic perovskite oxide thin film by sputtering the said ceramic target under Ar atmosphere or vacuum and temperature in a range of 400°C to 800°C.

(3) post-annealing of ferromagnetic perovskite oxide thin film in Ar atmosphere from 0 minutes to 2 hours.

ABSTRACT

Novel metal oxide compositions are disclosed. These ferromagnetic or ferrimagnetic compositions have resitivities that vary between those of semiconducting and insulating materials, and they further exhibit Curie temperatures greater than room temperature (i.e., greater than 300K). They are perovskite structures with the general chemical formulas $(A_{1-x}M_x)BO_3$, $(A_{1-x}M_x)(B'B'')O_3$ or $A(B_{1-x}M_x)O_3$, where A can be a 1^+, 2^+ and 3^+ charged ion; B can be a 5^+, 4^+, 3^+ charged ion; B' and B" can be 2+, 3^+, 4+, 5+ and 6^+ charged ion. M is a magnetic ion dopant. X-ray diffraction patterns are presented for exemplary compositions.

Attorney Docket No. 034172-017

COMBINED DECLARATION AND POWER OF ATTORNEY FOR UTILITY OR DESIGN PATENT APPLICATION

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

MAGNETIC DOPED PEROVSKITE OXIDES

the specification of which **(check only one item below)**:

☐ is attached hereto.

☒ was filed as United States Patent application Number 10/829,590 on April 21, 2004 and was amended on _____ (if applicable).

☐ was filed as PCT International application Number _____ on _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, § 1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §§ 119 (a)-(d), 172 or 365(a) of any foreign application(s) for patent or inventor's certificate or of any international (PCT) application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international (PCT) application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

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COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (MM/DD/YYYY)	PRIORITY CLAIMED UNDER 35 U.S.C. §§119, 172 OR 365(a)	
			Yes	No

I hereby appoint the attorneys and agents associated with the following PTO Customer Number of Burns, Doane, Swecker & Mathis, L.L.P. to prosecute said application and to transact all business in the Patent and Trademark Office connected therewith and to file, prosecute and transact all business in connection with international applications directed to said invention:

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

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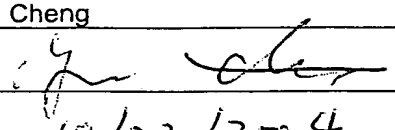
Signature	
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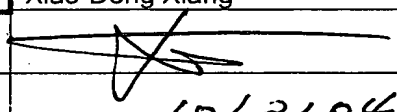
Signature	
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APPLICATION NUMBER	FILING OR 371 (c) DATE	FIRST NAMED APPLICANT	ATTORNEY DOCKET NUMBER
10/829,590	04/21/2004	Yi-Qun Li	

CONFIRMATION NO. 6712

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FORMALITIES LETTER

OC000000013188971

Date Mailed: 07/09/2004

NOTICE TO FILE MISSING PARTS OF NONPROVISIONAL APPLICATION

FILED UNDER 37 CFR 1.53(b)

Filing Date Granted

Items Required To Avoid Abandonment:

An application number and filing date have been accorded to this application. The item(s) indicated below, however, are missing. Applicant is given **TWO MONTHS** from the date of this Notice within which to file all required items and pay any fees required below to avoid abandonment. Extensions of time may be obtained by filing a petition accompanied by the extension fee under the provisions of 37 CFR 1.136(a).

- The statutory basic filing fee is insufficient.
  Applicant must submit $ **10** *to complete the basic filing fee for a small entity.*
- To avoid abandonment, a late filing fee or oath or declaration surcharge as set forth in 37 CFR 1.16(e) of $65 for a small entity in compliance with 37 CFR 1.27, must be submitted with the missing items identified in this letter.

The application is informal since it does not comply with the regulations for the reason(s) indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- A substitute specification in compliance with 37 CFR 1.52, 1.121(b)(3), and 1.125, is required. The specification, claims, or abstract page(s) submitted is not acceptable and cannot be scanned or properly stored because:
  - The line spacing on the specification, claims, or abstract is not 1½ or double spaced (see 37 CFR 1.52(b)).
- Replacement drawings in compliance with 37 CFR 1.84 and 37 CFR 1.121 are required. The drawings submitted are not acceptable because:
  - The drawings have a line quality that is too light to be reproduced (weight of all lines and letters must be heavy enough to permit adequate reproduction) or text that is illegible (reference characters, sheet numbers, and view numbers must be plain and legible) see 37 CFR 1.84(l) and (p)(1)); See Figure(s) 1.

- An abstract of the technical disclosure not exceeding 150 words in length and commencing on a separate sheet in compliance with 37 CFR 1.72(b) is required. An abstract was not provided for this application.

The applicant needs to satisfy supplemental fees problems indicated below.

The required item(s) identified below must be timely submitted to avoid abandonment:

- Additional claim fees of **$129** as a small entity, including any required multiple dependent claim fee, are required. Applicant must submit the additional claim fees or cancel the additional claims for which fees are due.

SUMMARY OF FEES DUE:

Total additional fee(s) required for this application is **$204** for a Small Entity

- **$10** Statutory basic filing fee.
- **$65** Late oath or declaration Surcharge.

- Total additional claim fee(s) for this application is **$129**
  - **$129** for **3** independent claims over 3.

Replies should be mailed to: Mail Stop Missing Parts
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